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[The following are translations of selected articles in the Russian-language monthly journal AVIATSIYA I KOSMONAVTIKA published in Moscow. Refer to the table of contents for a listing of any articles not translated.]

Reconnaissance Training Continues in the Face of Current Difficulties

93UM0130A Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 8, Aug 92 (signed to press 5 Jul 92) pp 4-5

[Article by Colonel (Reserve) V. Gatich under the rubric "Combat Training Proceeds": "Entrusted to the Masters"]

[Text] Russia and the other states of the Commonwealth are experiencing difficult times—the unified defensive system of the now-defunct superpower has been destroyed, and the once "united and fearsome" armed forces have been scattered among the national quarters. The question of the armed protection of each of the newly formed states is gaining particular significance at this stage.

The might of the army of Russia and its Air Forces, called upon to be the guarantor in preventing external aggression, is growing stronger. The military fliers, following the principle of "teach what is needed in war," are continuing to improve their professional mastery and combat proficiency under the conditions of today's economic and political instability. They include the personnel of the conversion-training center for flight personnel for reconnaissance aviation whose chief is Military Pilot-Expert Marksman Colonel A. Levchenko. Here is just one episode from the tactical flight training in which the aerial reconnaissance fliers took part.

A fighter/bomber subunit received the assignment of destroying an important "enemy" target. The area where it was deployed was only somewhat known. It was therefore decided to include reconnaissance crews in the performance of the mission; they were to execute the search and detect the assigned targets in the shortest possible times, perform aerial photography and simultaneously report to the command post of the strike aviation regiment by radio their precise coordinates before the performance of the mission.

The seeming simplicity of such a task entails a series of difficulties that demand coolness and restraint from the pilot and rule out the slightest false step on his part, even under conditions of peacetime training.

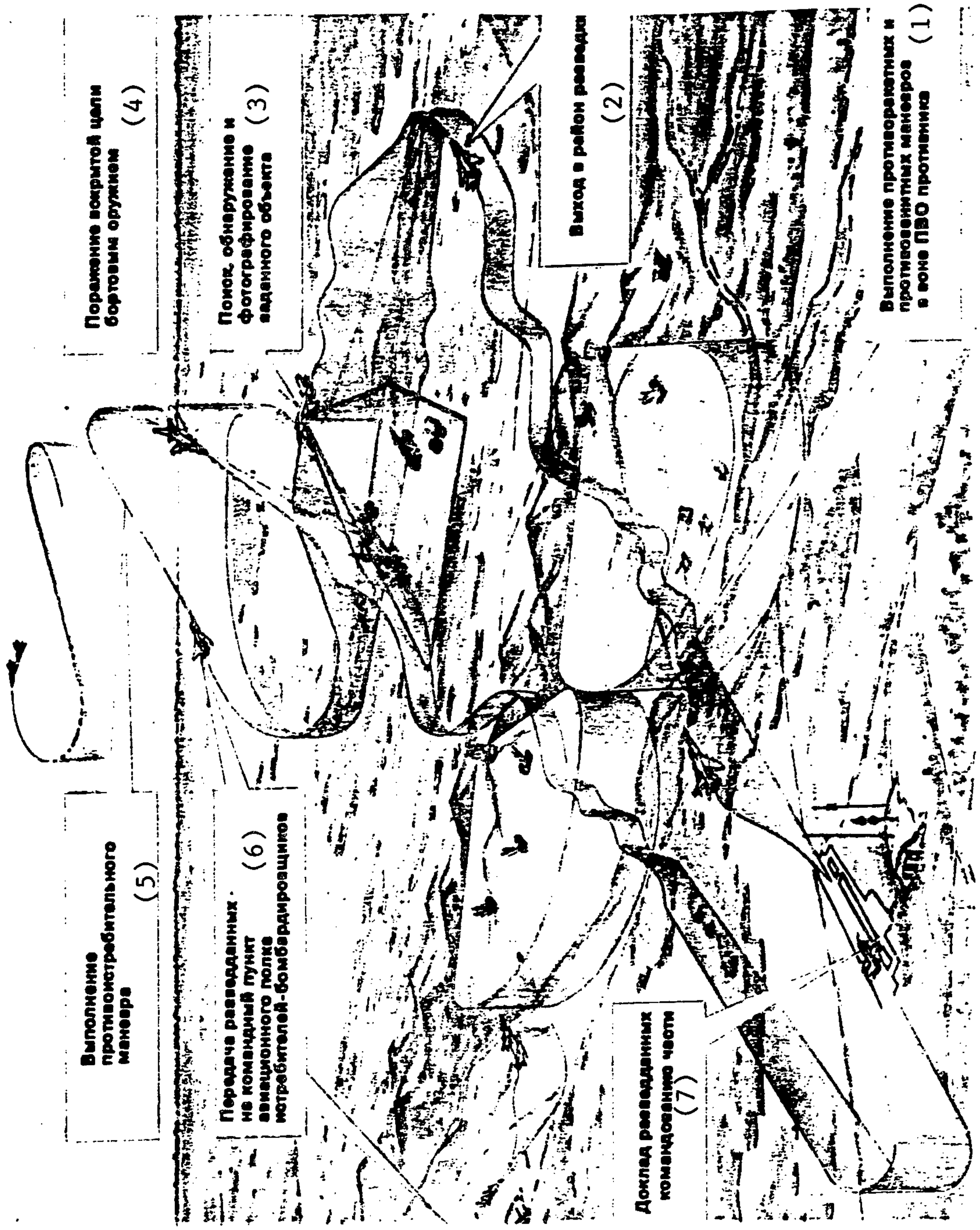
In order to perform aerial reconnaissance successfully, the pilot should not only determine correctly the most favorable period to perform it, but must also perform orientation constantly and pilot the combat aircraft in masterly fashion at low and very low altitudes, making competent use of terrain features, the maneuvering capabilities of his aircraft and the technical capabilities of the on-board reconnaissance equipment therein.

His principal task is to detect a carefully camouflaged target of the hypothetical enemy, determine precisely the coordinates of his location, transmit the reconnaissance data to the command post immediately, when necessary deprive the target of mobility and, overcoming all of the "hurdles" of the air defenses, return to his airfield.

And that difficult task was performed successfully. The fighter/bombers, utilizing the coordinates transmitted through the air, made the missile strike against the assigned target before the landing of the reconnaissance aircraft.

Reconnaissance pilots of the center Military Pilots 1st Class Guards Colonel V. Shabalin and A. Mironenko, Guards Lieutenant-Colonels V. Sinitskiy, V. Volkov and V. Zhdanov and Military Navigators 1st Class Guards Major G. Slepov and Guards Captain I. Goloveshchenko showed themselves to be true masters. They transfer their wealth of experience bit by bit to the younger generation on each flight operations shift.

The results of the tactical flight training reinforced the confidence of the command and personnel of the units and subunits that took part in it that the aerial proficiency of the pilots is at the proper level. The combat training of the fliers of Russia is continuing despite all of the difficulties.



Key:
1. execution of maneuvers against missiles and SAMs in enemy air-defense zone
2. reaching of reconnaissance area
3. search, detection and photographing of assigned target
4. strike against revealed target using on-board weaponry
5. performance of anti-fighter maneuvers
6. transmission of intelligence data to command post of fighter/bomber air regiment
7. report of intelligence data to unit command

Reasons for Simple Flying Errors Analyzed

93UM0130B Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 8, Aug 92 (signed to press 5 Jul 92) pp 6-7

[Article by Colonel V. Barachenkov under the rubric "Flight Safety: Experience, Analysis, Problems": "Is an Error Natural and Logical?"]

[Text] Operational experience shows that a significant share of the flight accidents in aviation units every year occurs due to the erroneous actions of the flight personnel taking part in supporting the functioning of the aviation system.

It is also necessary to note that one out of five flight accidents connected with the human factor is caused by the flight personnel when operating the aircraft in the air. The ratio is roughly the same with the preconditions to accidents. More than 50 percent of those "guilty" of mistakes in the operation of aircraft that led to accidents or the preconditions to them are typically 1st and 2nd class pilots, while flight personnel without class ratings commit no more than 30 percent of them.

The causes that could be cited for the mistakes made by young pilots include, first and foremost, the low level of their training, the loss of skills or the inadequate state of their performance capabilities and, in view of that, excessive tension in the air. It has been established that an experienced pilot can make a mistake as a consequence of an automatism he has acquired in actions, since he perceives discretely only a portion of the routine information, chiefly the initial, while the rest is seemingly guessed at in advance, thereby accelerating the process of decision-making (assessment) and performance of operations in controlling the aircraft. He can be performing several functions simultaneously. The distraction of attention away from the basic actions, at the same time, conceals a danger. If the actual flight parameters differ from those predicted and the pilot does not perceive those changes, his actions become unsuited to them. The result is the grossest of errors, which are sometimes aggravated in landslide fashion and lead to emergency situations.

Up to 80 percent of flight accidents and the preconditions to them arise in the takeoff and landing of the aircraft. These stages of the flight are the most complex and crucial. The increased pace of work for the pilot, as is well known, is typified by a high level of stress in the psycho-physiological functions of his body. All of the actions of the pilot are interconnected and form a unified cause-and-effect chain, in which the end of one link—a working operation—is the start of the next. The distraction of attention, coinciding in time with the moment of performance of the necessary operations, violates the accustomed pattern (stereotype) of the sequential actions of the flier, in view of which the performance of the next operation is postponed by him to a later point, and could be omitted altogether at a later time due to the shift in attention. The attention of the pilot of a MiG-21 aircraft in a landing approach, for example, who should have extended the flaps at that time, was distracted by a passing helicopter. Later, operating according to stereotype, the pilot performed all of the necessary actions, but he did not extend the flaps and the landing was made with them retracted.

The frequent repetition of mistakes by flight personnel when operating various types of aircraft has certain general laws. We note that the pilots of highly maneuverable aircraft with variable-geometry wings that are not fitted with built-in information systems to warn of a crew violation of the sequence of operations have a likelihood of committing an error that is much higher than for pilots of other types of winged craft. The largest quantity of mistakes by flight personnel due to the performance of a takeoff or landing with a wing sweep greater than that stipulated is noted on the Su-17, Su-24 and MiG-23 aircraft. The pilot, before taxiing out to the runway, should check the position of the swing portion of the wing along with other operations. But the need to perform a variety of operations and the strict requirement for the fulfillment of the flight plan increases the emotional stress on the crew, which predetermines the possibility of their making an error.

Monitoring of the position of the swing part of the wing on these types of aircraft is accomplished using an indicator or light signals, but five instances of takeoffs and landings with the wings set at a sweep angle greater than stipulated have already been noted, leading to flight accidents. Instances of the performance of aerobatic maneuvers on aircraft with a wing sweep that does not correspond to the flight mode have also been noted repeatedly.

The next most frequently encountered error in operating the aircraft is a landing approach with the gear retracted. The pilot obtains information on the position of the landing gear on most types of aircraft with the aid of light signals on the PPS, but he does not always—especially under stressful conditions—perceive it quickly and clearly. The question is a legitimate one in this regard—are these signals effective enough if a series of dangerous preconditions to flight accidents occurs every year connected with errors in the operation of the landing gear and the swing portion of the wing? Such errors are not encountered in aircraft that also have voice information in the pilot's headset (Su-27 and MiG-27) to back up the light signals.

The developers of new models of aircraft unfortunately do not take operating experience into account in their creation and do not improve the signal systems, although the psychological demands on the crew are increasing all the time. Potential conditions are thereby created for the making of mistakes as a result. The effectiveness of information systems could be increased through the use of voice information, preliminary logical processing of signals and constructive improvements in the systems for depicting information.

In considering the nature of errors by flight personnel connected with the high level of psychological strain at certain stages of flight, one also cannot fail to note the group of errors conditioned by a decline in the attention of the pilot. Quite a few instances are known where experienced and highly qualified pilots, performing a comparatively simple flight element, have made gross errors and created an emergency situation. Such flight accidents are difficult to explain from a purely logical standpoint, but from the viewpoint of psychological analysis they become understandable; a pilot who has executed advanced aerobatic maneuvers slacked off in the relatively simpler and more familiar ones, that is, the objectivity of perception decreased.

A pilot 1st class in a unit, for example, released the braking chute instead of lowering the landing lights when making a landing approach at night in good weather. The aircraft lost speed sharply, and its fall became inevitable. The pilot ejected...

How could this have happened? The situation was a simple one, after all, the aircraft was being controlled by an experienced pilot, and he made an error in the pre-landing descent—a comparatively simple portion of the flight for him... Analysis showed that the pilot, who had executed a complex flight assignment, was acting automatically in the concluding stages of it, without the proper self-monitoring. Even in the rapidly worsening situation he did not understand his mistake and transmitted by radio, "Something with the engine," without having concentrated on his actions when lowering the landing lights.

The pilot himself was to blame, of course. But the blame is less legal than "natural." The pilot had possibly not made for himself the immutable rule of maintaining attention through force of will to each stage of the flight, however simple it may have been. Having neglected his pre-flight rest, perhaps, it had an immediate effect on him, and ultimately on the success of the mission.

It would be expedient for anyone engaged in preventive work to ensure flight safety, when analyzing errors, to study their "derivation" and causes and develop scientifically substantiated recommendations for their elimination. The following must be kept in mind:

—the mistakes of a person are not random. They are directly associated with his personal qualities, attitude toward matters and the level of training in the field. Superficial and poorly training fliers make more mistakes than those who are demanding of themselves and disciplined;

—mistakes are made in an accustomed situation due to carelessness, imprudence and inattentiveness; and

—mistakes are made systematically first and foremost in places where the requisite attention is not paid to eliminating their causes.

The poor organization of the training and execution of flights, inadequate support for them, the posing of assignments beyond capabilities and hasty changes in them all condition the appearance of mistakes in the work of flight personnel. Each commander and each pilot himself must therefore "dig down" to the true causes of errors leading to complications of flight conditions, and take steps to avert their appearance in the future.

Air-Cushion Aircraft Developed Through Individual Initiative

93UM0130C Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 8, Aug 92 (signed to press 5 Jul 92) p 9

[Article by A. Shubalov under the rubric "Conversion of the VPK [Military-Industrial Complex]: Day by Day": "Places Where a Geologist Will Not Go..."]

[Text] The aircraft plunged into the smooth water surface of Lake Lunskoye almost without a splash, and then the tail and outstretched wings, like giant floats, appeared above the surface... Someone then felt that if a mark were to be given to that "dive," it would get the highest! True, the nose portion of the fuselage was deformed from the impact.

That occurred on 3 Aug 90. O. Cheremukhin, the hero of the episode described, getting out of the hospital in two weeks, was occupied first and foremost with an analysis of what had happened, since both the flight and the fall of the aircraft had been captured on videotape. It was necessary to answer the main question—who was to blame for the fall, the aircraft or the pilot?

Oleg Aleksandrovich, studying the behavior of the craft in the air with stopwatch in hand, came to the unequivocal conclusion that he himself was to blame for the crash—he had made several gross errors in piloting, as the result of which there was not enough engine thrust and the aircraft had lost speed and dropped. The design elicited no doubts overall.

A collective of enthusiasts that included, aside from the chief designer (the pilot), his close assistants and like thinkers Andrey Chistyakov, Aleksandr Rakov and others, set about the restoration work. Just who were they, where and as what were they working, what possessed them in their quest? These were people that were devoted first and foremost to the skies...

It is generally recognized that design forecasting in aviation today can proceed in three directions, founded on a new idea, new materials and new assemblies. The novelty in this case was the idea itself. The Poisk-01A aircraft, after all, was an original phenomenon in the domestic practice of aircraft construction, distinguished first and foremost by the air-cushion landing gear, providing for its operation from diverse, unprepared sites. The task of the creative research was to check out the

stability, controllability and external loads in takeoff and landing for the purpose of ascertaining the limits of restrictions. That is what the official document says.

The new member of the aircraft family—or more precisely, the experimental prototype of it—is being created in Nizhniy Novgorod at the Aviation Production Association imeni S. Ordzhonikidze.

The history of the Poisk is unfortunately a better illustration of the last decade of stagnation and restructuring, since more than ten years, after all, have passed since the birth of the idea to its practical incarnation. Those years have had everything—hope and disappointment, enthusiasm and hopelessness, triumph and failure. One can only tip one's hat to the doggedness with which the collective of like thinkers has surmounted the obstacles that arose on its path.

The author of the project, Oleg Aleksandrovich Cheremukhin, is an uncommon person in aircraft building. His boy's passion for aircraft modeling pre-ordained his later fate. He entered the Kazan Aviation Institute after secondary school, and was sent in placement to one of the leading KBs [design bureaus]. Here, in the process of working on air-cushion craft, the idea arose in him, seeming foolhardy to many of the venerable engineers, of combining what at first glance could not be combined.

"That cannot be!" one of them declared. "An imbalance of the whole design will arise in the retraction of the skirt of the landing gear/platform, and no one has yet been able to solve this problem."

The first aircraft appeared in 1979, a year after the first successful experiment with a model. Cheremukhin manufactured it with the guys from the aircraft modeling club at the Sormovskiy Pioneer Hall.

The first step is always the hardest. Field testing revealed a host of defects. The work to improve the design stretched out to several years. And how could it have been otherwise, when they had to obtain the metal, the plywood, the lumber, canvas and much more themselves, frequently with their own money.

They installed an engine from a Buran snowmobile (it provided horizontal thrust) and two five-horsepower engines from Ural power saws, which were placed at the base of the landing gear to create the air cushion on the aircraft. The day of flight testing finally arrived, on 3 Jul 89.

The pilot gained an altitude of 30 meters and came around. But the aircraft did not have enough thrust at a bank angle of more than 30°, which led to a loss of speed and a wing stall.

The pilot was fortunately not injured, but the aircraft was sad to see. The only thing that took the edge off the bitterness of the failure was the conclusion of a prestigious committee that "The aircraft is stable in pitch, but the vertical empennage is too small; the thesis is interesting and further research would be expedient."

The Poisk-01A took off for the first time from the water and came back down on 3 Jul 90. The pilot seated in the cockpit could not tell from his own sensations the type of surface.

And then, on August 3, came the crash of the aircraft, almost costing its creator his life. The next round of restoration work ensued after that. Reduction gearing that increased the thrust was installed on the engine.

The year flew by without notice. Yet another in a long line of years that lay between the idea that had once flashed and the genuine triumph that occurred in the summer of 1991 at the next review of the craft, this time in Chernigov.

As late as a few moments before the takeoff, the skeptics did not believe that this "cart" could fly. Its appearance was too unconventional. It could, as we see, if one approaches the matter with sober calculation and an irrepressible thirst to attain the goal.

"The aircraft is permitted to be operated" was the conclusion of the prestigious commission. It creators, by the way, had been sure of that!

O. Cheremukhin and his group have been working at the firm of TRANSAL for more than a year now, occupied at their own production association with the design engineering and manufacture of experimental prototypes of aircraft for the 21st century. A four-seat air-cushion aircraft is being developed based on the Poisk-01A—a dream of geologists, forest workers, shepherds, reindeer breeders and petroleum workers...

Measures to Prevent Aircraft-Bird Collisions Summarized

93UM0130D Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 8, Aug 92 (signed to press 5 Jul 92) p 11

[Article by Candidate of Military Sciences Colonel N. Tsupko under the rubric "Flight Safety: Advice of a Specialist": "Migratory Birds Are Flying..."]

[Text] The migration of birds is beginning with the approach of fall, and with it increases the danger of collisions with aircraft.

An average of 2,300 such collisions is recorded each year in the U.S. Air Force, according to information from the group BASH (Bird/Aircraft Strike Hazard), with material damage valued at roughly 20 million dollars. It must be assumed that those values are no less for us, if one considers that the economic losses from flight accidents increased almost ten times over from 1965 through 1988.

The methods used to avert collisions of aircraft with birds in the air that have traditionally been employed include scaring them away and, in a number of cases, their physical destruction at airfields. This unfortunately

has only a one-time effect and does not eliminate the reasons for their accumulation. This problem, in my opinion, should be considered from another aspect—in connection with questions of the protection of the environment. The recommendations of ornithologists, who know well the nature and conditions of bird habitation, should be used so as not only to scare them away from airfields, but also to alter the ecology in the area it is located in order to break up the birds.

Based on the concepts for averting flight accidents, it may be said that the immediate cause of a collision with birds is the making of flights without regard for the ornithological situation. The main reason is connected with a factor that is hazardous for flights—the accumulation of birds at an airfield and the regions adjoining it. The chiefs of weather services and other officials taking part in planning, organizing and supporting flights should possess the broadest of information in this realm.

Birds are attracted to any region, as is well known, by the habitat—the availability of food, the safety of nesting, rest and sleep. The principal condition for the successful performance of measures to reduce their accumulation should thus be a knowledge of the ecological and ornithological situation in the area of the airfield at various times of the year. A study of the environment surrounding the airfield should be performed to ascertain it, using a helicopter at a radius of 20—25 kilometers during the periods of the mass spring and fall migrations of birds at the beginning of spring and the middle of the fall; the start of nesting at the end of spring; during the rearing of offspring at the beginning of summer; and, mass post-nesting migration at the beginning of the fall.

Those sections of terrain where the gathering of flocks of birds is most likely (farmlands, trash dumps, livestock grazing areas, river valleys, the edges of forests, stands of brush, bodies of water and the like) should be studied especially carefully. The study of each section of the territory is best done 3—4 times a day (morning, afternoon, evening and, sometimes, at night), insofar as the concentration of birds could vary over the course of the day.

It must be kept in mind that each seasonal period has its own characteristic features for preventing their accumulation. Early spring is for them a time of shortage of food and the choice of nesting sites. The flight field of an airfield, as is well known to all fliers, is covered with fresh greenery earlier than the other territories adjoining it. The biological mass of the new plants is significantly higher than the past year's dead stands, and the birds use the airfield as a feeding area. The instinct for self-preservation, however, is stronger in the birds than the need for food at a time when a nesting site has not yet been selected. The principal measures for reducing their accumulation during this period will thus be scaring them away and eliminating nesting conditions.

The intensive use of mobile bioacoustic installations, reproducing the warning cries of birds in combination with the firing of signal rockets with a smoke or light trail, provides positive results in scaring away birds at airfields. This scaring off is best done every day. Among the useful methods for eliminating nesting conditions for birds in the area of the airfield could be cutting down and uprooting stands of brush and small trees, trimming upper branches with nesting colonies from large trees, draining damp and swampy areas and cutting shore vegetation at bodies of water.

When gatherings of gulls, rooks, crow, jackdaws, starlings and sparrows are detected in the area of an airfield, steps must be taken to eliminate nearby dumps of trash and food wastes or to move them no closer than 15 kilometers from the airfield. One must proceed in designating a new location for trash from the fact that the routes of birds flying from nesting sites not cross the glides paths of runways.

It should be noted that at the beginning of the summer, during the feeding of offspring—and this period lasts two-three weeks—the birds do not react to methods of scaring them away. A battle is underway for their place in the habitat and for survival. The parents feed the new hatchlings 40—60 times a day. The rate of their flights from nesting locations to the sources of food increases proportionately, as does the likelihood of aircraft collisions with them accordingly. It is best to refrain from planning flights at low altitudes during this period to prevent such incidents. The justice of this proposal is confirmed by the fact that the largest amount of aircraft damage from collisions with large birds is noted during flights being performed to make strikes against ground targets, and those are made, as a rule, at low altitude.

Particular attention should be devoted during the spring-summer period, in my opinion, to a possible change in the ecological situation in the area of airfields. Land, as is well known, is being transferred to private use. The farmer, its new owner, will be using it in his own way. The commandant of an airfield must understand that factors that are favorable for attracting birds and undesirable from the standpoint of possible aircraft collisions with birds are the daytime plowing of sowing areas, especially on flight days, the construction of poultry and livestock farms, the ranging of poultry and grazing of livestock, the equipping of slaughterhouses, the storage of wastes and organic fertilizers, farming on fruit and berry plantations and the like.

The quantity of birds at an airfield can increase by 4—5 times in the second half of the summer if measures have not been taken to break them up. A young bird that has quit the nest, timid, flies in an uncertain manner. Means of scaring them off—sound signals and visual annoyances (colored flags, fluttering scarecrows, glittering balls etc.)—can help drive them away from the airfield. It is also recommended to cut the grass on the flight field to a height of no more than 20-25 centimeters; that height does not provide safety for birds feeding in the grass, and they leave those areas.

At the beginning of the fall, in the mass post-nesting migrations of the birds, the operators of radar stations can help the pilots avoid collisions with birds. They should increase their radar monitoring of the movements of the birds, identify them on the screens correctly and warn the flight operations officer in operative fashion, with he in turn warning flight personnel who are in the air or preparing for a flight.

A danger of collisions with aircraft can be posed during the winter by crows, rooks and jackdaws—that is, non-migratory birds concentrated in the area of urban sumps. They behave in particularly uneasy fashion before thaws and drops in atmospheric pressure. Large flocks gather in trees to spend the nights. It is expedient to drive out the bird flocks, making several flights in a helicopter or using other active means, before a flight during this period in order to prevent the collision of aircraft with the birds.

All of the measures to eliminate conditions facilitating the accumulation of birds in the area of an airfield must be performed only in coordination with, and with the aid of, the local authorities, environmental-protection societies, ecological groups of the city sanitary and epidemiological station and the inspectorates of the bodies for the protection of natural habitat.

Streamlined and Better-Targeted Servicing of Aircraft Being Tried

93UM0130E Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 8, Aug 92 (signed to press 5 Jul 92) pp 16-17

[Article by Major-General of Aviation V. Ishutko under the rubric "Combat Training: Problems of the IAS": "Time Does Not Wait..."]

[Text] The IAS [Aviation Engineering Service] of armed forces aviation has been entrusted with diverse tasks to maintain its combat readiness and ensure flight safety. The fact that from 70 to 80 percent of the personnel of aviation units are specialists in the aviation engineering services testifies to the complexity and high labor-intensiveness of the processes of ensuring the required working order of the aircraft inventory, preparing the aviation hardware for flights at the stipulated times, restoring aviation equipment that has sustained combat or operational damage and technical training of flight and engineering-technical personnel (ITS).

The role of the specialists in fulfilling a flight assignment is, perhaps, commensurate with the role of the flight crew, since success in the air is impossible if the aircraft systems are not tuned and adjusted sufficiently well.

The ever-increasing combat capabilities and rising complexity of modern aircraft, on the one hand, as well as the well-known difficulties with logistical support for their operation and outfitting by IAS personnel, on the other, are causing not only the persistent necessity of a rise in the effectiveness of all IAS operations, but are also worsening its most urgent problems. The requirements for professional selection and training of specialists have increased sharply with the advent of the Su-27 and MiG-31 aircraft, but there are fewer and fewer opportunities to fulfill them for political, demographic, ethnic and other reasons. The burdens are thereby increasing on those who are serving at the airfields.

Virtually every engineering supervisor of the IAS knows today that the actual labor expenditures for the performance of the regularly scheduled amount of servicing and maintenance (TO) of aircraft exceeds those available, that some of the requirements of the uniform regulations for servicing and maintenance (RO) are not well-founded, some are clearly not needed and some are even harmful. This is perceived in various ways by the technical personnel, but ultimately, under the influence of various types of disturbances (first and foremost a shortage of time), even the most crucial operations can end up not being performed. The way out of this situation is seen in improving the systems for aircraft servicing and maintenance.

The systems for that servicing and maintenance that currently exist—crew-group and technical teams—have their own merits and drawbacks. First among the drawbacks are the uneven burdens on the engineers and technicians of differing specialties when preparing an aircraft, the repeated turning on of one and the same systems therein and the "erosion" of responsibility for the readiness of the aircraft for flight (from 10 to 15 people sign for it in the aircraft preparation logbook).

The system of TO using technical teams is more promising overall. It offers an opportunity to realize in particular the potential of the most capable and creatively thinking officers of the IAS regardless of their specialties. It is, however, also not free of substantial drawbacks. The repetition of one and the same check-outs is envisaged here, the same as in the crew-group system. An aircraft, for example, completed a flight shift without any remarks—that is, it underwent verification under real, considerably tougher conditions than ground conditions. According to the RO, however, it is subject to check-out by specialists when preparing it for the next flights, and then again by the flight crew immediately before the flights. And that is an excessive use of equipment, additional peak-load burdens and, therefore, a decline in reliability and an increase in the consumption of its service life and labor expenditures.

The discussion concerns aircraft systems whose monitoring does not provide any guarantee of their failure-free operation over a certain period of time. If their check-out were to be removed from the routine servicing and maintenance, the ITS would obtain the additional time so essential to perform the really crucial operations and for engineering and technical training. The overall level of the latter everywhere lags behind what is required to guarantee the prompt revealing of hazardous design or production defects, many of which are still

detected only when investigating the causes of flight accidents and the preconditions to them. The IAS supervisory personnel in the units are meanwhile engaged in patching organizational tears in an unsuccessful attempt to ensure the fulfillment of the volume of work assigned in the RO, without having the time either to supplement their own technical knowledge or to analyze the reliability of the aviation hardware.

If it is also taken into account that the existing TO systems do not allow the use of an aircraft at an intensity that would provide the required flying time for the flight personnel, the more and more insistent necessity of a fundamental improvement in the system of aircraft servicing and maintenance becomes obvious. It is namely for that reason that the experimental verification of a system for preparing aircraft using technical teams has been underway in a number of PVO [air-defense] air units since January of 1991. Its essence is as follows. Technical crews (according to the number of aircraft) and two technical teams (for servicing and field repairs, diagnostics and research of the technical condition) are formed from IAS specialists in each air squadron. The technical crew has two or three people depending on the type of aircraft. They are best staffed with two officers for Su-27, MiG-31 and MiG-25 aircraft; that makes it possible to compensate for the virtually complete absence of junior aviation specialists and to make efficient use of the IAS officers under conditions of cutbacks in the armed forces. This crew, without the involvement of other specialists, performs the preflight preparation of the aircraft and preparations for repeat sorties, and releases it for the flight.

If no failures are detected on a flight shift and no more than seven days have passed since, the flight crew checks out the equipment under current load in the amount stipulated in the manual for flight servicing and maintenance.

The technical crew, headed by an engineer/aircraft operator, performs inspection operations and the remaining check-outs in accordance with specially developed documentation. The amount of check-outs has been cut back substantially from the amount indicated in the RO through the exclusion of those that provide no guarantee whatsoever of the failure-free operation of the systems after their performance.

Permitting specialists to perform the duties of an engineer/operator is done on a strictly individual basis. Practice shows that the intensity and responsibility of the work of engineer/operators is considerably higher than that of aircraft technicians, and the increase in the rating category and salaries was thus entirely warranted. Their corresponding additional training to carry out the experiment was performed right in the air units by engineers of the units, large units and formations. Its organization at higher educational institutions is planned in the future.

The technical team for the servicing and field repair of aircraft is charged with the tasks of finding and eliminating failures and damage of the aircraft hardware of the squadron. This team performs the mounting of the air ordnance, the recharging of gases and complex check-outs during the period of preflight preparation on aircraft seven days from the start of their idle time when preparing aircraft for flights.

The corresponding set of operations is performed by the manpower and equipment of the team for diagnostics and research of the technical condition on every aircraft in the air squadron after 50 +/- 5 hours of flying time and no less often than once every 60 days. That includes the extensive inspection of the airframe, weaponry, instrument monitoring of system parameters, analysis of the materials of objective monitoring and any failures or damage that exist, which ensures an individual approach to evaluating the state of the aircraft. A forecast is made of the quality of functioning of its units, assemblies, systems, equipment and armaments on the basis of the analysis. The results obtained make it possible to make a decision both on permitting the aircraft to make further flights or to perform additional checks for it, and to adjust the full amount of impending operations on it (the latter to eliminate redundancy of work in the air squadrons and servicing and repair unit of the air regiment).

Combat readiness is expected to rise thanks to the adoption of the TO system using technical crews (through the increased flying hours per aircraft and for each pilot accordingly, along with the elimination of the necessity of restructuring the aviation engineering support for a particular period), aircraft reliability indicators will improve (via a reduction in run time on the ground, a decrease in the number of system uses, the extensive study of the technical state of aircraft hardware and a preventive analysis of its reliability), the skills of the ITS will rise (through the freeing up of additional time for technical training with cutbacks in labor expenditures for TO) and the utilization factors of the performers of the aircraft servicing and maintenance work will be evened off.

The system has been tried out in several PVO formations. The principal difficulty, in my opinion, was overcoming conservatism in the thinking of the IAS supervisory personnel. Long service under conditions of strict centralization and the habit of acting on instructions from above also naturally had an impact. The functioning of this system requires creativity in work, a continuous analysis of its results and the institution of the appropriate adjustments, along with the ability to manage available manpower and equipment correctly.

Methodological instructions for organizing the servicing and maintenance of aircraft by technical crews that were worked out at the PVO [Air Defense] Aviation Directorate define only the basic provisions and principles of the TO system, providing the formations with the opportunity of a creative approach to carrying out the experiment. It is my firm conviction that the system for the

servicing and maintenance of aircraft will never be perfected without giving the formations, large units and other units opportunities for displaying initiative and independence. The actual effectiveness of the system currently being tested in PVO aviation is still difficult to evaluate owing to the negative effects on its functioning of interruptions in the supply of fuels, lubricants and spare parts and the extremely limited capabilities of the aviation technical units. The first year of the experiment has already shown, however, that with all conditions being equal the capabilities of the IAS to support flying time have increased, routine servicing and maintenance have become less laborious and the average flying time before a failure or damage in flight has not declined.

Further adjustments in the amount of operations in the preparation of aircraft, the elimination of routine servicing operations according to calendar time frames and a future transition to servicing and maintaining aircraft according to their condition are envisaged in accordance with the results of the experimental servicing and maintenance of aircraft that is being carried out.

The basic substance of the preparation of aircraft would currently seem to be composed of analyzing the amount of work for aircraft TO as set by the requirements of the servicing and maintenance documentation, adjusting for the purpose of ruling out useless operations and distributing the amount obtained to the air squadron (for performance by the team for diagnostics and researching technical condition) and the servicing and repair units of the air regiment.

Full conversion to the servicing and maintenance of aircraft according to its condition is envisaged in aviation of the armed forces by the year 2000. Scientists at NIIs [scientific-research institutes] are working out its methodology. It would be no offense to them to say that it should proceed from actual, dynamic practice, which they may not know in the necessary detail at the NIIs. Field units, especially those stationed in the regions with the harshest climatic conditions, are already spontaneously servicing aircraft according to their condition to a considerable extent. Life itself thus demands that we grant the initiative to the branches of aviation and formations, only indicating for them the aims, tasks, rough stages and basic principles of this conversion.

American Pilot's Impressions of Su-27, MiG-29 Flights Recounted

93UM0130F Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 8, Aug 92 (signed to press 5 Jul 92) pp 22-23

[Article prepared by A. Sheyman under the rubric "Opinion": "With a Discount for Roughness"]

[Text] Today, when the policy of Cold War has been consigned to the dustbin of history, we are more and more often witnesses to events, the possibility of which was difficult to imagine even just five-seven years ago. Domestic combat aircraft that were "supersecret" until quite recently, for example, are today displayed successfully at international air shows and exhibitions and NATO pilots are making familiarization flights on them; according to their opinions, the MiG-29 and Su-27 are extra-class craft.

Here in particular is how they are evaluated by a very experienced military pilot who has at one time or another flown virtually all types of American and West European fighters, in an article with the intriguing title "Soviet Super-Fighters. How Do They Compare to the Best American Ones?" that appeared in the magazine POPULAR MECHANICS. Its author, David M. North, was the first of the overseas pilots to make familiarization flights in MiG-29 UB and Su-27 UB dual trainers. Today he is the executive editor of the well-known air and space weekly AVIATION WEEK AND SPACE TECHNOLOGY.

With the appearance of these fighters Soviet aircraft building, in the opinion of D. North, took a large step forward in the realm of employing the latest technologies. A purely "Soviet" principle of aircraft construction—simplicity plus reliability—is reflected in them at the same time. Some Western specialists reproach their creators for the fact that they give preference to quantity to the detriment of quality. But one should clearly not forget that the aim of ensuring short-term high reliability of the MiG-29 and Su-27 under combat conditions was being pursued first and foremost in the design engineering of these aircraft, while the Western concept of designing aircraft in this class is aimed at long-term reliability under peacetime conditions. Furthermore, he continues, these aircraft—which is especially important—are not "tied" to fixed airfields; both have devices in their air intakes preventing the entry of foreign objects when based on dirt airfields—which the foreign models of fighters, by the way, do not have.

The "indifference," in the words of North, of our designers to finishing the surface of the fuselages of the aircraft is readily apparent, and it can be compared neither with the American McDonnell-Douglas F/A-18 nor the General Dynamics F-16. He nonetheless makes the reservation that the "important" parts of both aircraft are designed so carefully that certain "allowances" can be made for their outward appearances. He summed all of this up in a somewhat humorous vein: "...a little rough, but agile, simple and effective."

The author later shares his own impressions on the instrumentation in the cockpits of our aircraft, which struck him as "old-fashioned" and reminiscent of the equipment of American fighters that were built back in the 1970s. Instruments with round dials predominated, in his opinion, while various on-board systems were significantly inferior to the electronics of the F/A-18 and later models of the F-16, F-15 and F-14 in the level of "integration." This situation, however, could be radically altered in the near future, as North notes, insofar as

the equipping of the cockpit of the "twenty-nine" with multifunctional displays is planned in the future.

North, in his words, was struck by the fact that the fighters from Mikoyan and Sukhoy were equipped with an electro-optic aiming system that supported the "concealed" (since it is a passive system) lock-on and tracking of an airborne target. An analogous system is in the development stage in the United States. Its installation on the F-14D is planned for the future, and it will enter service no sooner than in two years.

North also shared his impressions of the familiarization flights.

North went up in the rear seat of the MiG dual trainer with Mikoyan OKB [Experimental Design Bureau] Chief Test Pilot Valeriy Menitskiy at the beginning of 1990 during a visit to the Kubinka airfield near Moscow. The view from the forward cockpit of the MiG-29 UB was marvelous, according to the American pilot, and from the rear cockpit simply abysmal due to the highly placed instrument panel. The periscope was unfortunately not operative during the flight.

North describes the flight itself this way: "After the aircraft had gathered enough speed in the takeoff run, I pulled back on the stick and the aircraft, having covered a total of only about 300 meters on the runway, easily shot upwards at a speed of 230 km/hr. A somewhat outmoded control system is installed on the MiG-29, in my opinion. It nonetheless makes it possible to alter the banking angle of the aircraft at a rate of 250 degrees/second, and to alter pitch at 30 deg/sec. It must be acknowledged that these characteristics are better than the first models of the F-15 and are commensurate with the analogous indicators for the F/A-18, which has a remote-control system.

"I switched the engines to idle mode and created an angle of attack of 35 degrees by pulling back slowly on the stick, in order to get an idea of the controllability of the aircraft at low speeds. The speed of the MiG dropped to 155 km/hr and it shook somewhat, although it maintained good bank and pitch response throughout the whole maneuver. It was easy for me to conclude that the MiG-29 is as stable at large angles of attack as the F/A-18, which is similar to it in outward appearance.

"After having executed a series of advanced aerobatic maneuvers, I began accelerating in afterburner mode. It must be acknowledged that this maneuver is performed as efficiently on the MiG-29 as on the best NATO fighters that I have flown..."

The flight visibility was poor in landing approach, and David was not surprisingly somewhat confused due to his lack of flying according to "unfamiliar looking" instruments and asked our pilot to complete the flight. The slight confusion of North in flying the MiG-29 was caused by the specific features of changes in the banking and pitch according to the artificial horizon—one of the basic piloting and navigational instruments (the principles of the indication of readings of the artificial horizon differ significantly here and abroad—*author*). Soviet specialists, as North jokingly noted, often compare the operation of our piloting instruments with the "American view of the outside world."

North made a familiarization flight in the forward cockpit of the Su-27 UB at the end of September 1990 at Farnborough with Sukhoy OKB Test Pilot Viktor Pugachev.

The Su-27, as attested by the American pilot, may be compared in geometric and weight characteristics with the F-15 and F-14, but it is considerably superior to them in takeoff and landing properties. It is enough to compare the lengths of the takeoff runs—335 and 600 meters! The Su-27 is equipped with a four-channel remote-control system and, what is noteworthy, the reaction of the aircraft to movements of the stick is faster than could be expected. North executed controlled rolls and solitary half-rolls (so as to get a feel for the aircraft), a half-eight on the vertical plane, a low-speed loop and a high G-force turn in the practice area. The aircraft was stable during the piloting process, while displaying enviable maneuvering qualities characteristic of aircraft of smaller dimensions. Pugachev then make a dynamic braking of the aircraft—the famous "Pugachev cobra." He established a speed of 400 km/hr at an altitude of 3,000 meters and, pulling back energetically on the stick, created a pitch angle of 90 degrees. The aircraft nonetheless continued to move in the original direction. The speed dropped to 153 km/hr. After that the trainer was smoothly "put onto the horizontal." North doubted that this maneuver could play a decisive role in achieving victory in an aerial battle, although its execution is a visible demonstration of the high maneuverability indicators of the aircraft.

The American also noted the striking thrust-to-weight ratios of the MiG-29 and Su-27, allowing the pilots to gain altitude almost vertically directly from takeoff.

Relying not only on his personal impressions from the flights on modern Soviet fighters but also on information obtained from its creators at the OKB, North drew the logical conclusion that it is not possible to assert the unequivocal superiority of either the Soviet or American fighters. The winner's laurels, however, would go to the fighters from the Western countries, in his opinion, in aerial battles at medium and long ranges through the use of more reliable systems of detection and identification, as well as the use of the improved class of AMRAAM air-to-air missiles. It would be difficult, on the other hand, to rival the pilot of the Su-27 or MiG-29 using a passive search and tracking system. Victory in a close-quarters aerial battle, despite all of this, would ultimately go to the pilot who had complete mastery of the equipment he was flying.

While praising the unique piloting characteristics of the MiG-29 and Su-27 aircraft, North regards his article as a

brief analysis of the results of the rivalry between the United States and the former USSR in the realm of aircraft building over the long years of the Cold War, giving due respect therein to the talents of our aviation designers.

Review of Space-Based Solar-Power Plant Proposal

93UM0130G Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 8, Aug 92 (signed to press 5 Jul 92) pp 38-39

[Article by I. Kurkin and M. Kukolev[1] under the rubric "A Look at a Problem": "Energy From Space"]

[Text] *People searching for ecologically clean sources of energy are directing their attention more and more toward the sun. Continuing the discussion that was begun in our journal (1991, Nos. 3 and 5), we offer to the readers a plan for a space-based solar electric-power plant developed under the leadership of Professor D. Sevruk at the Moscow Aviation Institute [MAI].*

American engineer P. Glazer came out in 1968 with an engineering proposal to create a new power system. The idea consisted of deploying solar-panel arrays in near-Earth orbits to obtain electric power and transmit it by microwave emissions to the Earth. Industrial customers would be supplied after the conversion of the emissions back into electric power.

Specialists in various countries have been conducting design-engineering research since that time. More and more realistic and technically feasible plans for the creation of power systems using photoelements or thermal converters are being developed. Both variations are proceeding seemingly equally, and the ultimate choice in favor of this or that one can evidently be made after the testing of model low-capacity stations under space conditions.

We will consider the question—of no small importance—of the orbits for positioning these power plants. It would be most advisable, in the opinion of many specialists, to give preference to a so-called geostationary orbit. Having the shape of a circle and located on the equatorial plane of the Earth at an altitude of 36,000 from its surface, it has one valuable trait—at that orbit, due to the equal duration of Earth days to the orbital period of the satellite, the latter is constantly located above one and the same point on the Earth's surface, thereby easing the process of transmitting energy. The power plant, due to the fact that the equatorial plane is inclined at an altitude of 23.5° to the elliptical plane, is effectively illuminated by the sun continuously during the whole year (the duration of the "shadowing" is only about one percent).

It is being proposed to convert the electric power generated (with an efficiency factor of more than 85 percent) into superhigh-frequency emissions and to direct it, with the aid of a focusing transmitting antenna, to a receiving antenna on Earth with a diameter ten times larger. The optimal frequency is 2450 MHz from the standpoint of losses when passing through the atmosphere and the dimensions of the receiving and transmitting antennas. These emissions are used in industry and medicine. It must be said that the intensity of the field at the center of the SHF beam will not exceed 230—870 W/m^2. We would point out, by way of comparison, that solar radiation on the Earth's surface can have an intensity of about 1 kW/m^2. A protective zone that is closed to uncontrolled passage and the presence of outsiders surrounds the receiving antenna in order to increase safety. An emergency beam defocusing system is actuated in the event an emergency situation arises, and the power of the emissions is reduced to a safe level.

We will move on now to a more detailed consideration of the design of the space electric-power plant. It is an installation with a thermal converter for the solar emissions into electrical current. The open and light design should provide only the necessary rigidity to preserve its shape within the assigned limits.

The specialists at MAI made it their aim in design engineering of the power plant to create several base modules, with the aid of which many tasks could be performed. This approach makes it possible to reduce the cost of the program to deploy the power plants, and could speed up its realization. Each individual module can be employed not only as a constituent element of a large-capacity electric-power plant, but also as an independent power installation for a conventional satellite or orbital station. Fig. 2 presents the design configuration of a base module of 100 kW. Its subsystems include 1—the mirror/solar emissions concentrator, 2—the receiver of the emissions with the deconcentration system, 3—a turbogenerator, 4—a cooler/emitter and 5—a mechanism to open up the power module and put it into operating condition.

The operating principle of the module is as follows: a mirror concentrates the solar radiation falling on it onto a thermal receiver. A heat medium circulating within the latter is heated to approximately 830°C and enters a turbine that rotates the shaft of an electric generator. The medium is cooled after the turbine in a radiator/cooler and enters a compressor, and then back again to the thermal receiver.

While under Earth conditions the dissipation of unused heat can be accomplished quite effectively through convection in the air or thanks to the pumping of a coolant or gas, in space this is possible only through thermal emissions from the surface of the heated material. It is namely for that reason that one of the principal elements is the so-called cooler/radiator, which is a flat surface of a light material that conducts heat well and with a certain arrangement of pipes on it. The medium from the turbogenerator runs through them, releasing heat to the elements of the structure, which dissipates it into the

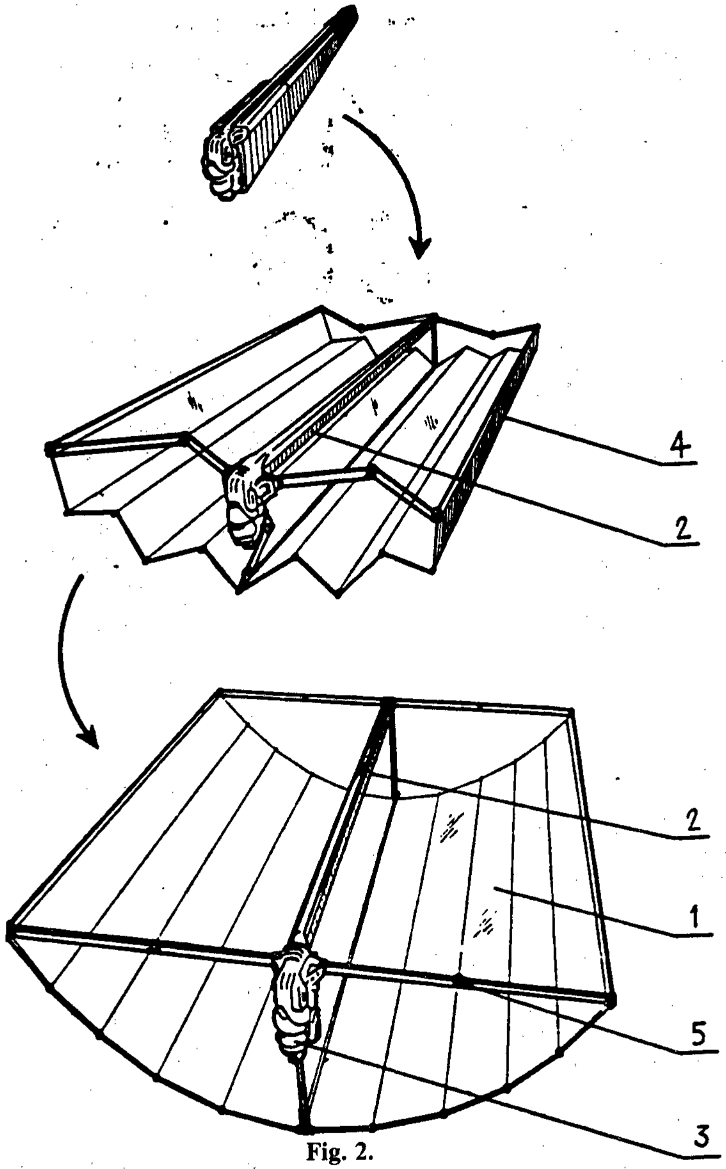


Fig. 2.

surrounding space. An argon-xenon gas mixture is proposed to be used as the heat medium.

The reflecting surface of the concentrator is a thin film of silver, aluminum or gold. Silver has the best reflecting ability—96 percent. The aluminum is only 4 percent less. This coating could quickly lose its properties in space without the taking of special steps, and the efficiency factor of the installation would thus decline as well, decreasing the electric-power generating capacity. The reflecting surface is coated with a thin transparent film, SiO_2 or Al_2O_3 for example, for protection.

Electro-rocket motors are used for the precise orientation of the mirror at the sun, an essential condition to ensure efficient functioning.

The cooler/radiator is located on the rear portion of the concentrator in relation to the sun. This allows it always to be in the shade, thereby easing the task of releasing heat that is not utilized. The design combination of the concentrator and the cooler/radiator was envisaged in order to reduce the overall mass of the installation. Their unfavorable effects on each other are eliminated by the correct organization of the movement of the thermal fluxes.

The mirror of the solar-power installation should ideally have the shape of a paraboloid of revolution; it would then possess the best power characteristics. In the course of the work, however, taking into account the requirements for simplicity of manufacture, compactness in

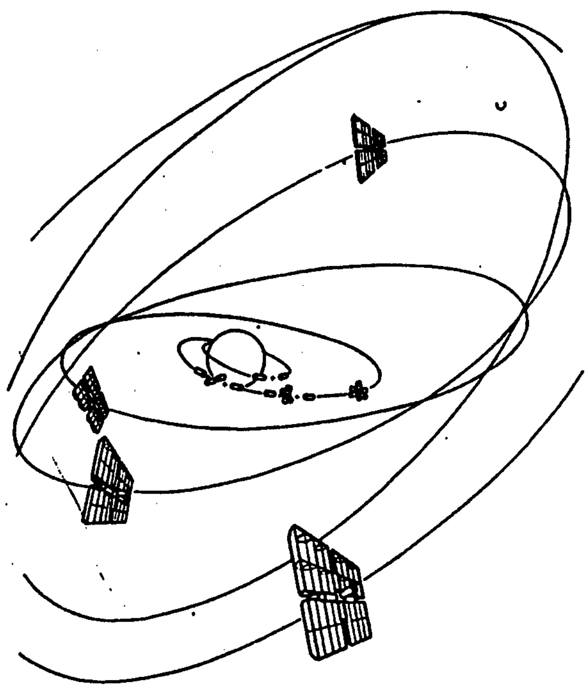


Fig. 1.

stowed form when being launched and the convenience of the overall configuration, the choice was a cylinder with a parabolic shape in cross-section with an additional concentrator.

An installation with an overall capacity of six megawatts is launched into reference orbit with the aid of one Energiya launch vehicle in that case. There the container with the stowed modules is partially opened up, and the deployed modules begin to feed power to ion or plasma engines. The power unit begins to accelerate itself on a spiral around the Earth (Fig. 1). Upon achieving the altitude of the working orbit, there is the final opening of all the structures, and the new power installation is hooked up to the platform of the electric-power plant.

An efficiency factor for the conversion of solar emissions into electrical current of up to 29 percent is possible using this type of electric-power plant. Taking into account the fact that the full efficiency factor of the channel for transmitting electric power from orbit to a consumer on Earth is 70 percent, the following correlation is obtained: the solar emissions falling on each square meter of the mirror/concentrator will provide 280 W of electric power to a surface consumer. With a space power plant with a capacity of six MW, we will have 4.2 MW of electric power on Earth.

A skeptically inclined reader, seeing these figures, will possibly say, "A multitude of rocket launches—which is harmful to the Earth's atmosphere—will be required to replace even one nuclear-power plant with solar electric-power plants! Would it not be better to improve those nuclear-power plants on land, or to be actively engaged in raising the efficiency factor of thermal electric-power plants?"

We would like to note, without in any way coming out against such ways of developing power engineering, that the project that is being offered to the reader will make it possible not only to solve the problem of the "power hunger" of people on Earth, but also to lay the foundation both for the launch of harmful types of production into space and to make use of the resources of outer space. The delivery of all of the elements of the power installations into orbit from Earth is required only in the initial stages. The power plants themselves will be able to be built in space from materials obtained from heavenly bodies, to the extent of the gradual development of plants in orbits and on the moon.

The creation of space settlements, the idea for which was advanced as far back as K. Tsiolkovskiy, would in turn become possible. Research on this issue is currently being conducted by Professor J. O'Neil of the United States. His work will make it possible to conclude that with the use of solar power, even with today's technologies, the building of artificial settlements in space will make it possible to remove almost all industry from the Earth's surface in less than a century. The requirements for electric power would naturally decline on Earth, and the cleaning of its air and water would gradually begin.

The supply of power to the Earth from space will thereby be another essential stage on the path of development of mankind.

Footnote

1. The authors have asked that the honorarium due them be paid to the fund of the "Onward to Mars!" aerospace formation.

KOSMINFORM Summary of Space News Items

93UM0130H Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 8, Aug 92 (signed to press 5 Jul 92) p 39

[Text] **United States.** Certain difficulties may arise when performing a piloted landing in astronauts who have worked on the Space Shuttle for roughly three months, according to data from physiological research. Testing of an automated, computer-controlled on-board landing system is projected in the course of one of the flights of those craft being planned for 1993 in this regard.

Astronaut J. Young has proposed conducting tests of that system according to a Soviet technique, placing the actual gear on a training aircraft. The realization of this program, however, is not considered to be very likely due to the high expenditures and large amount of time required.

* NASA is currently studying the possibility of assembling the necessary data for the creation of a permanent moon base with the aid of robot craft launched from its surface. Equipment for extracting and producing oxygen, fuel and building materials from local resources will be able to be tested with the aid of such craft. This concept, which has received the name of Artemis, also envisages the delivery of a telescope one meter in diameter to a pre-selected site, with an image sharpness ten times higher than when operating under Earth conditions.

The **ESA** has signed a contract with the firm of Dornier (Germany) for the development and manufacture of the Biobox installation to conduct biological experiments under space conditions. This installation is expected to be used on board the West European satellite Bion-10, whose launch will probably be made from the Plesetsk Cosmodrome using the Soviet Foton returnable capsule.

PRC. The international consortium of Intelsat is conducting negotiations with the Chinese corporation of Great Wall on the possibility of putting the Intelsat-7A satellite into orbit. Launches of these satellites were earlier made using the Ariane and Atlas rockets. It is assumed that the launch of a satellite by a Chinese rocket will be cheaper. The consortium will possibly encounter difficulties connected with the ban on the export of American satellites to the PRC.

Japan. The rapid development of satellite communications is expected, according to some estimates by experts, in the Pacific Ocean region in 1990. The question of granting every citizen the right to receive information directly from space requires immediate resolution as a consequence of this. The private ownership of satellite antennas is prohibited in the PRC, Malaysia, South Korea and Singapore, while in Japan the receipt of foreign programs transmitted on satellite channels is not permitted.

Foreign television companies, despite the bans, are finding an opportunity to market their television programs in Japan, making use of surface communications lines for that purpose. The American television company CNN intends to obtain the permission of the Japanese government for the direct rebroadcast of its programs through a privately owned satellite. Ten Japanese firms have applied for licenses to expand the rebroadcasting of television programs through space communications satellites.

North Vietnamese Fighter Tactics Against U.S. Bombers Recalled

93UM0130I Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 8, Aug 92 (signed to press 5 Jul 92) pp 42-43

[Article by Hero of the Soviet Union Major-General of Aviation (Retired) M. Fesenko under the rubric "Aviation in Local Wars": "The Vietnam Syndrome"; continued from No. 7]

[Text]

Partisan Warfare

I came down the ramp of an Il-18 that had made the Moscow—Hanoi run on 10 Oct 72, onto the Vietnamese soil tormented by a war that even the Americans called "dirty." Twenty-seven years after the Great Patriotic War, which I had ended as the commander of an Il-2 assault-aircraft squadron, I was once again to plunge headfirst into combat work, only now in the post of advisor to the commander of the VPA [Vietnamese People's Army] Air Forces.

I would like to note that my entry into that post had begun with an evaluation of the prevailing situation and a practical familiarization with the conditions of combat operations.

The U.S. air group in Southeast Asia by the fall of 1972 already numbered about 1,200 aircraft and helicopters. Its basic striking power was 188 strategic bombers, 360 tactical fighters, 184 attack aircraft and 96 Navy fighters. The crews of most of those aircraft had substantial combat experience behind them by that time.

The armaments of the VPA Air Forces, meanwhile, were four fighter, transport and training regiments based in the area of Hanoi at the airfields of Zea-Lam, Noi-Bai, Yen-Bai and Kep, with Soviet-made MiG-21 and MiG-17 aircraft and F-6s (MiG-19s) from the PRC. There were just 71 aircraft out of the 187 that were combat-ready, and only 47 (31 MiG-21s and 16 MiG-17s) of them were involved in the performance of practical tasks. Matters were no better with the training of the flight personnel—only 13 of the 194 Vietnamese pilots were able to wage solo combat operations at night, while the rest went up only during the daylight hours.

The no-less-difficult situation with the combat readiness of the VPA Air Forces was a direct consequence of the air operation conducted by the Americans in the spring of 1972 under the code name Linebacker-1, in the course of which 40 destructive bombing attacks were made against areas of concentration of Vietnamese aviation. The intact "repelling forces" were forced to operate only sporadically and in small groups due to the disabling of the runways at most airfields and the considerable losses of hardware on the ground.

The quantitative superiority that was possessed by the U.S. Air Force in the air over the enemy, which ultimately also predetermined the direction of the search for tactics for the operations of their aviation by both sides, is often emphasized in features that were published right after the war in Vietnam. It is no wonder that the North Vietnamese were forced to place their bet namely on "partisan" methods of waging warfare in the face of such a disposition of forces. The small quantity (remember, 47) of combat-ready interceptors was also reflected in the "distribution" of the number of American aircraft shot

down: the greater portion of them, of course, were attributable to the air-defense missile subunits of the VPA PVO [air defenses].

It had become known to the command of the Vietnamese Air Forces in the middle of October that the Americans were soon planning to conduct a second air operation called Linebacker-2. The foundation of it, according to the intentions of the aggressor, was to be strikes by B-52 strategic bombers at night (most likely taking into account the poor training of the flight personnel of the VPA fighter aviation for night operations, especially in bad weather conditions). The entry into battle of the fighter pilots who had mastered the Red Flag program—in the completion of which an "aggressor squadron" of F-5 aircraft (similar in characteristics to the MiG-21) operated as the "enemy" and employed the tactics of fighter aviation of the Soviet Air Forces—was also planned.

Our military advisors, along with the aviation command of the VPA, began developing variations of restraining operations on the verge of that operation. We all understood very well that it was not rational to send the whole "group" of 47 into the thick of it right away. The enemy, of course, would have suffered certain losses in clashes with the Vietnamese fighters, but would at the same time have maintained a considerable portion of his forces for subsequent strikes, while there would most likely have been no one left to defend. After a careful analysis of the situation we decided, first of all, to determine the optimal procedure for pairs (flights) of interceptors to go up and their execution of missile attacks that were unexpected by the enemy, wagering therein on the economical expenditure of forces and surprise operations.

The intent was as follows: without repudiating the tactical concepts of the three prior stages of the war, to try to adapt them to the conditions of waging combat operations at night, directing the principal efforts of their aviation toward the destruction of enemy strategic bombers. They intended to organize for that purpose the training of experienced pilots in the performance of intercepts of airborne targets at night. Training the Vietnamese pilots in this type of combat application did not pose any particular difficulties—their Soviet instructor colleagues had mastered it long before.

But war made its own corrections to theory—an attacking MiG-21, when operating on the emissions of radar sights, was thereby revealing itself, giving the enemy an opportunity of executing defensive maneuvers that most often led to a break-off of the attack. The North Vietnamese pilots, recalling the necessity of striking the enemy by surprise, began aiming by day using a conventional sight (with solid visual contact with the target), and executing a missile launch only after receiving a signal on the "lock-on" of the enemy aircraft by the missile homing head. But that could only be done during the day. How could an attack be made in a similar fashion at night? Our search for an effective method of operations for fighter aviation under such specific conditions of waging warfare remained fruitless.

At the end of October American aviation unexpectedly halted its mass strikes against airfields in the DRV, which allowed the North Vietnamese to carry out immediate reconstruction and repair of the damaged runways. This process usually took from three to ten days. An "airfields maneuver" was thus proposed in order to maintain the readiness of the alert flights of interceptors—in cases where a runway was unsuitable for operation, the pilots took off from the taxiway using jet-booster units and, after completing their assignment, landed at back-up airfields.

An analysis of the actions of American aviation when carrying out mass strikes made it possible to note their adherence to stereotype, which eased to a certain extent the task of planning intercept sorties and the organization of ambushes of fighters in the air, which we always tried to confine to the assumed time and place of appearance of the principal strikes of aggressor groups.

The support measures that they performed in a certain sequence involuntarily assisted the opposing side in orienting itself to their intentions and making well-founded decisions to employ a limited number of fighters. Attempts to traverse strictly the zones that were blinded by active jamming of the detection and guidance radar of the Vietnamese PVO thus forced the crews of U.S. strike aviation to structure themselves in dense battle formations that were easily detected visually in cloudless weather by the MiG-21 pilots.

All decisions to send up fighters were made in general at the central command post of the Air Forces and PVO, where the overall situation was evaluated, the general detail of forces and takeoff airfields was determined and the specific combat task was stipulated. The commander of the regiment was assigned only dispatcher functions (supervision of takeoffs and landings), even though his command post guided the combat aircraft in his responsibility zone. I feel that this was a clear drawback in the scheme for combat command and control, since as important an echelon as the regiment—which was right where the preparation of the flight personnel for the performance of the given mission was carried out—was essentially excluded.

We understood at the same time that it was technically impossible to endow each level of this scheme—the formation, unit and subunit—with its own command and control bodies (with detection and guidance equipment). We were thus forced to resort to rigid centralization under conditions of frequent changes in the situation.

We were convinced of the correctness of the countermeasures that were undertaken by North Vietnamese aviation that had been developed on the basis of a careful analysis and forecasting of the operational tactics of the aerial enemy after the completion of the Linebacker-2 operation (at the end of December). It must be

said that the aggressor, using chess terms, was making few "moves" at the time that we could not discern in advance. Whence the small number of mistakes in the decisions we made. *(To be continued)*

Comparison of Tu-22M3, FB-111A Bomber Data

93UM0130J Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 8, Aug 92 (signed to press 5 Jul 92) pp 46-47

[Article by V. Ilin under the rubric "Information for Reflection": "Bombers"]

[Text] *Third-generation heavy and medium jet bombers were developed at the end of the 1960s and beginning of the 1970s. These were supersonic aircraft with variable-geometry wings: the Tu-22M in the USSR and the FB-111A in the United States.*

The creators of the Tu-22M (with series modifications Tu-22M2 and Tu-22M3) initially took the path of improvements to the Tu-22. A fundamentally new type of combat aircraft ultimately went into service.

The FB-111A was developed on the basis of a fighter-bomber. The fact that it was the first strategic bomber in the world with a variable-geometry wing is noteworthy.

Tu-22M

Crew. Four men.

Dimensions. Wingspan of 34.28/23.30 meters, sweep angles at the leading edge (minimum/maximum) of 20°/65°; length of aircraft 42.46 meters, height 11.05 meters.

Mass. Maximum takeoff mass 124,000 kg [kilograms] (126,400 using jet-booster takeoff units), maximum landing mass 88,000 kg, normal landing mass 78,000 kg.

Flight characteristics. Top speed 2,300 km/hr [kilometers/hour]; effective operating radius (depending on ordnance load and flight profile) 1,500—2,500 km; effective ceiling (at Mach 1.3) 14,000 meters; takeoff run 1,920 meters, landing runout 1,250—1,450 meters; maximum operating G-forces 2.5.

Engines. NK-22 turbojet bypass engines with afterburner (Tu-22M and Tu-22M2, 2 x 22,000 kgf) or NK-25 (2 x 25,000 kgf).

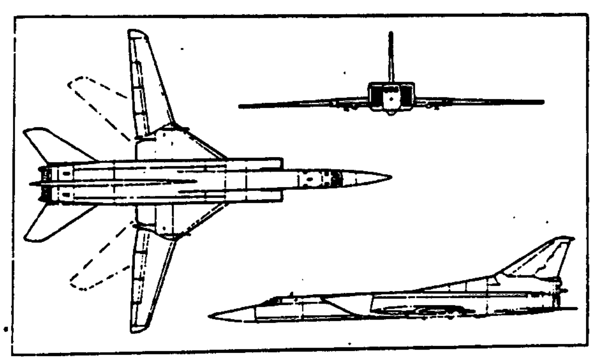
Armaments. The aircraft is equipped with guided missiles, as well as free-fall nuclear and conventional bombs in various combinations, for example three missiles intended for the destruction naval and surface stationary targets. (One of the missiles is under the fuselage in a semi-recessed position, and two are on the wing weapons racks.) Six short-range missiles can be accommodated in the bomb bay on a drum launcher. Bombs up to 24,000 kg in mass are hung in the weapons bays in two fuselage and two wing multiple-shackle bomb racks. A GSh-23 cannon (two on the Tu-22M2) with a remote-control system that has television and radar channels is mounted in the tail section (a pod with a braking chute is installed instead on the Tu-22M).

Equipment. Long-range radar providing for the detection of land and naval targets, an optical bombsight and an inertial navigational system. The "drogue-probe" aerial refueling system has been removed in accordance with the terms of the SALT II Treaty. There is an automated rescue system (minimum speed for separate ejection at low altitude is 130 km/hr, forced ejection 300 km/hr, with the speed for ejection not restricted at altitudes above 60 meters). Active and passive EW systems.

Status. In service with the Air Forces and Navy, series produced. Production limited to 30 aircraft a year in accordance with a Protocol to the SALT II Treaty.

Additional information. Work under the program was begun in the first half of the 1960s with the aim of modernizing the Tu-22M series aircraft (no decision was made in advance to create a new aircraft). The takeoff and landing characteristics were improved and the flight range was increased somewhat thanks to the variable-geometry wing. The field of view from the forward cockpit ahead and downward was improved compared to the Tu-22M. The crew has two pilots. The aircraft surpasses all foreign series-produced strategic bombers in bomb load, with the exception of the considerably heavier Boeing B-52 and Convair B-36 aircraft (although the foreign press has reported that the Rockwell B-1B bomber can carry 34,000 kg of bombs, the effective bomb load of that aircraft does not exceed 20,000 kg).

The Tu-22M aircraft and its modifications, which have received the NATO designation of Backfire, have become somewhat well-known around the world after they became the "stumbling block" in the negotiations on the limitation of strategic arms (SALT II) between the USSR and the United States. These bombers, in the opinion of American specialists, should be counted as a strategic weapon, with the Soviets insisting that the Tu-22M, like the FB-111, was a tactical weapon. A compromise was ultimately reached—the Backfire bombers were not counted as a strategic weapon, but the



USSR was obligated to remove the aerial refueling hoses from all aircraft of this type and to reduce their annual production. Several Tu-22M2 aircraft were used in the concluding stage of the combat operations in Afghanistan.

FB-111A

Crew. Two men.

Dimensions. Wingspan of 21.34/10.34 meters, area (depending on wing sweep angle) 57.3/66.8 m^2, sweep angles at the leading edge (minimum/maximum) of 16°/72°30'; length of aircraft 22.4 meters, height 5.19 meters.

Mass. Maximum takeoff mass 54,000 kg [kilograms], normal takeoff mass 45,360 kg, empty aircraft 22,220 kg.

Flight characteristics. Top speed 2,200 km/hr at altitude of 12,000 meters and 1,150 km/hr at low altitude; effective ceiling 14,500 meters, minimum altitude when penetrating air defenses 60—160 meters (depending on relief of terrain); maximum acceleration 90 meters/second; maximum ferry range with external tanks 6,580 km, flight range at high altitude without external tanks and with four SRAM missiles 4,000 km, combat operating radius with two SRAM missiles and two external tanks when flying at high altitude 2,900 km; takeoff run 1,850 meters; maximum operating G-forces of four.

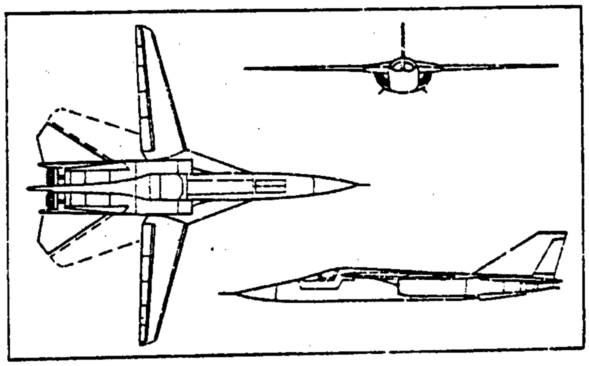
Engines. Pratt & Whitney TF30—P-7 turbojet bypass engines with afterburner (2 x 9,230 kgf).

Armaments. The aircraft is intended primarily for carying out strikes using nuclear missiles and bombs and is equipped with four AGM-69A SRAM missiles (two in the fuselage and two under the wing) or four B43, B57 or B61 free-fall bombs. The bomb load is 4,000 kg (the press has reported repeatedly that the maximum bomb load of the FB-111A can reach 10,000 kg, but under realistic combat conditions that cannot be attained).

Equipment. The Mk.28 integrated system, which includes an inertial navigational system, cockpit instrumentation and an on-board control panel for the SRAM missile launches. Additional navigational equipment consists of an astrocompass from the firm of Litton and the AN/APN-185 Doppler radar from General Precision. General Electric AN/APQ-111 fire-control radar and AN/APQ-128 terrain-following radar have been installed on the aircraft, along with the Texas Instruments AN/APN-176 radio altimeter and an optical sight.

Status. In service with the U.S. Air Force (there were about 60 bombers in service in 1991).

Additional information. The U.S. Strategic Air Command faced the problem of upgrading the bomber fleet, which was equipped by and large with the Boeing B-47 and B-52 subsonic high-altitude bombers that did not fully meet Air Force requirements, after the rejection of the programs for the North American B-70 Valkyrie supersonic high-altitude aircraft, as well as the poor



operating characteristics of the Convair B-58 Hustler bomber. The decision was made in 1965 to create a new strike aircraft based on the F-111 fighter/bomber, which had made its first flight in 1964.

The first flight of the experimental bomber was made in July of 1967, with series production in 1968-71. The building of 235 F-111A aircraft was originally expected, but research conducted by the U.S. Air Force in 1968 showed that this aircraft could not perform the functions of an intercontinental bomber due to its insufficient range and small ordnance load. Only 76 bombers were built in all, with the price of each aircraft 12.5 million dollars (at the exchange rates for the beginning of the 1970s).

Work to upgrade the aircraft began in 1989 in the variation F-111G, intended for tactical aviation. The retrofitting of the entire FB-111A fleet into F-111Gs is expected to be completed in 1994. The aircraft are equipped with a system to drop non-nuclear weapons (with the retention of the AGM-69 SRAM missile as an armament), a new EW system, the Have Quick ultrashortwave decimeter-band radio set and an automated, digital control system.

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